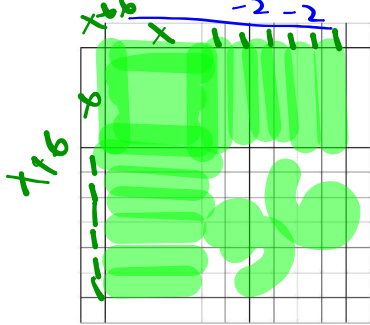


** If the equation is originally set equal to a number other than 0, get it equal to 0 first ** If a is not 1, you will need to factor out a first **

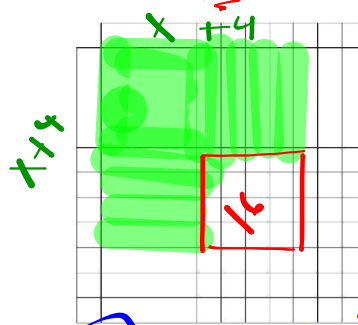
1) $x^2 + 12x + 30 = 2$



$x^2 + 12x + 28 = 0$
 $(x+6)^2 - 8 = 0$
 $(x+6)^2 - 8 = 0$
 $(x+6)^2 = 8$
 $x+6 = \pm\sqrt{8}$
 $x+6 = 2\sqrt{2}$
 $x+6 = -2\sqrt{2}$
 $x = -6 + 2\sqrt{2}$
 $x = -6 - 2\sqrt{2}$

Solve by RM $x = -6 \pm 2\sqrt{2}$
 $x = -6 - 2\sqrt{2}$

2) $x^2 + 8x - 20 = 0$

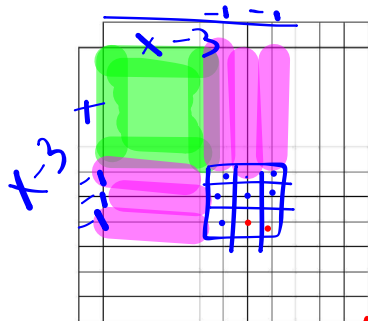


$(x+4)^2 - 36 = 0$
 $0 = (x+4)^2 - 36$
 $(x+4)^2 - 36 = 0$
 $(x+4)^2 = 36$
 $x+4 = \pm\sqrt{36}$
 $x+4 = 6$
 $x+4 = -6$
 $x = 2$
 $x = -10$

$-20 + x = 16$
 $+20 + x = 16$
 $x = 36$

borrow 36

3) $x^2 - 6x + 8 = 1$



$x^2 - 6x + 7 = 0$
 $y = (x-3)^2 - 2$
 $0 = (x-3)^2 - 2$
 $(x-3)^2 - 2 = 0$
 $(x-3)^2 = 2$
 $x-3 = \pm\sqrt{2}$
 $x-3 = \sqrt{2}$
 $x-3 = -\sqrt{2}$
 $x = 3 + \sqrt{2}$
 $x = 3 - \sqrt{2}$

Borrow 2

Completing the Square

- X terms, b was even
- x^2 term, a was ONE
- Treat like perfect trinomial

last term
 middle term
 2

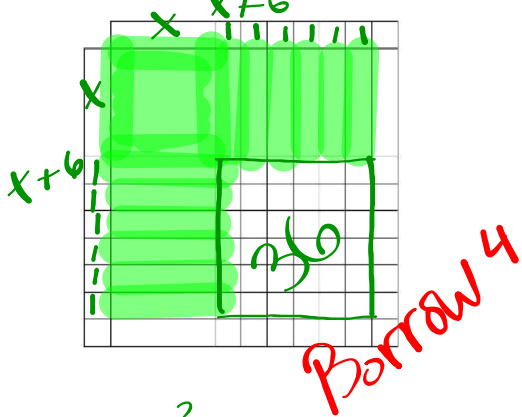
Good morning!

1. "Here"
2. Discuss completing the square activity
3. Practice with steps
4. Discriminant to find number of solutions

Completing the Square Practice

Complete the square to find the roots of the following functions.

1) $x^2 + 12x + 32 = 0$



$(x+6)^2 - 4 = 0$

$(x+6)^2 - 4 = 0$
+4 +4

$\sqrt{(x+6)^2} = \sqrt{4}$
 $x+6 = \pm 2$

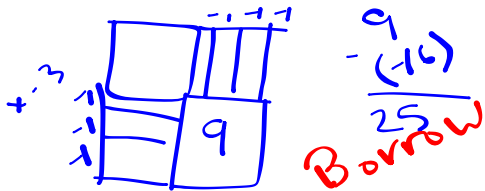
$x+6 = 2$
-6 -6
 $x = -4$

$x+6 = -2$
-6 -6
 $x = -8$

draw your own diagram

3) $x^2 - 6x - 10 = 6$

$x^2 - 6x - 16 = 0$



$(x-3)^2 - 25 = 0$

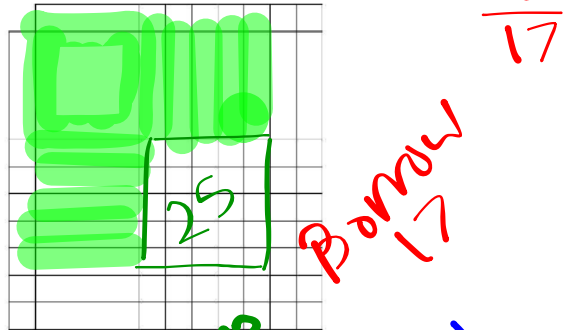
$\sqrt{(x-3)^2} = \sqrt{25}$

$x-3 = \pm 5$

$x-3 = 5$
+3 +3
 $x = 8$

$x-3 = -5$
+3 +3
 $x = -2$

2) $x^2 + 10x + 8 = 0$



$(x+5)^2 - 17 = 0$
+17 +17

$(x+5)^2 = 17$

$x = -5 \pm \sqrt{17}$

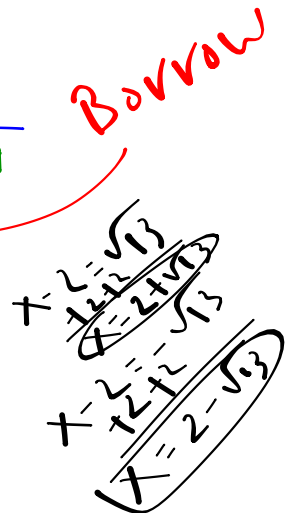
4) $x^2 - 4x - 9 = 0$

$x^2 - 4x - 9 = 0$

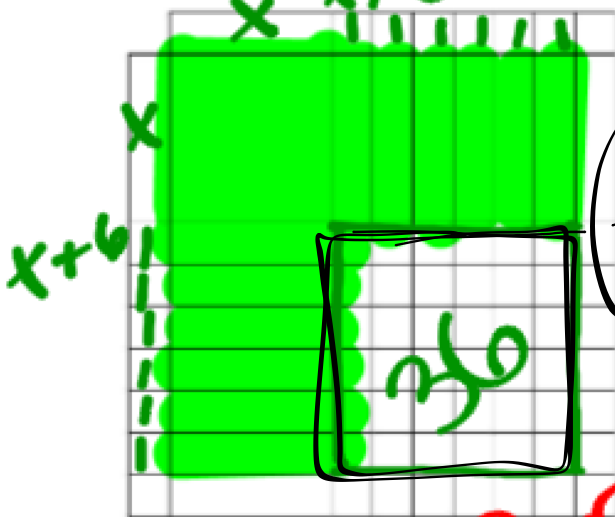
$x^2 - 4x + 4 = 9 + 4$
 $\sqrt{(x-2)^2} = \sqrt{13}$

$x-2 = \pm \sqrt{13}$
+2 +2

$x = 2 \pm \sqrt{13}$



1) $x^2 + 12x - 32 = 0$



Borrow 4

$$x^2 + 12x + 32 = 0$$

$$\begin{array}{r} -32 \quad -32 \\ \hline \end{array}$$

$$x^2 + 12x + 36 - 36 - 32$$

$$(x+6)^2 = 4$$

$$\begin{array}{r} -4 \quad -4 \\ \hline \end{array}$$

$$(x+6)^2 - 4 = 0$$

$$(x+6)^2 - 4 = 4$$

$$(x+6)^2 - 4 = 0$$

$$\begin{array}{r} +4 \quad +4 \end{array}$$

$$\sqrt{(x+6)^2} = \sqrt{4}$$

$$x+6 = \pm 2$$

$$\begin{array}{r} x+6 = 2 \\ -6 \quad -6 \\ \hline \end{array}$$

$$\boxed{x = -4}$$

$$\begin{array}{r} x+6 = -2 \\ -6 \quad -6 \\ \hline \end{array}$$

$$\boxed{x = -8}$$

Elementary Algebra 5811

Solving Quadratic Equations: Completing the Square

Solve each equation by completing the square.

1) $x^2 + 2x - 24 = 0$

2) $p^2 + 12p - 54 = 0$

3) $x^2 - 8x + 15 = 0$

4) $r^2 + 18r + 56 = 0$

5) $m^2 - 6m - 55 = 0$

6) $m^2 - 4m - 91 = 0$

7) $m^2 + 16m - 32 = -7$

8) $r^2 - 8r = -8$

9) $n^2 = -14n - 37$

10) $n^2 - 2n = 15$

11) $x^2 + 15x + 15 = 2 + x$

12) $-3n^2 + 4n - 59 = -4n^2$

13) $5n^2 - 20n + 6 = 0$

14) $3a^2 - 6a - 34 = 0$

15) $3x^2 - x - 3 = 0$

16) $2v^2 + 5v - 7 = 0$

17) $4n^2 + 11n = 15$

18) $9a^2 - 21 = 13a$

19) $3m^2 - 10m + 11 = 4$

20) $3m^2 - 16m - 2 = -7$

Algebra 2 - Unit 1

Name _____ ID: 1

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Solving Quadratics by Completing the Square

Date _____ Period _____

Solve each equation by completing the square.

1) $x^2 + 2x - 6 = 0$

2) $p^2 - 2p - 39 = 0$

Handwritten work for equation 1: $x^2 + 2x - 6 = 0$

$x^2 + 2x + 1 = 6 + 1$ (adding +6 +6)

$\sqrt{(x+1)^2} = \sqrt{7}$

$x+1 = \pm\sqrt{7}$

$x = -1 \pm \sqrt{7}$

Handwritten work for equation 2: $p^2 - 2p - 39 = 0$

$p^2 - 2p + 1 = 39 + 1$ (adding +6 +6)

$\sqrt{(p-1)^2} = \sqrt{40}$

$p-1 = \pm\sqrt{40}$

$p = 1 \pm 2\sqrt{10}$

Handwritten work for equation 3: $m^2 - 8m - 48 = 0$

$m^2 - 8m + 16 = 48 + 16$ (adding +6 +6)

$\sqrt{(m-4)^2} = \sqrt{64}$

$m-4 = \pm 8$

$m = 4 \pm 8$

$m = -4$ or $m = 12$

Handwritten work for equation 4: $v^2 - 12v - 57 = 0$

$v^2 - 12v + 36 = 57 + 36$ (adding +6 +6)

$\sqrt{(v-6)^2} = \sqrt{93}$

$v-6 = \pm\sqrt{93}$

$v = 6 \pm \sqrt{93}$

5) $p^2 + 14p + 60 = -5$

6) $n^2 - 18n + 96 = 9$

7) $x^2 + 18x + 42 = -10$

8) $n^2 - 8n - 58 = 7$

Handwritten work for equation 7: $x^2 + 18x + 42 = -10$

$x^2 + 18x + 81 = -52 + 81$ (adding +6 +6)

$\sqrt{(x+9)^2} = \sqrt{29}$

$x+9 = \pm\sqrt{29}$

$x = -9 \pm \sqrt{29}$

Handwritten work for equation 8: $n^2 - 8n - 58 = 7$

$n^2 - 8n + 16 = 65 + 16$ (adding +6 +6)

$\sqrt{(n-4)^2} = \sqrt{81}$

$n-4 = \pm 9$

$n = 4 \pm 9$

$n = -5$ or $n = 13$

Handwritten work for equation 9: $p^2 + 2p - 72 = -2$

$p^2 + 2p + 1 = 70 + 1$ (adding +6 +6)

$\sqrt{(p+1)^2} = \sqrt{71}$

$p+1 = \pm\sqrt{71}$

$p = -1 \pm \sqrt{71}$

Handwritten work for equation 10: $p^2 - 10p - 81 = -9$

$p^2 - 10p + 25 = 72 + 25$ (adding +6 +6)

$\sqrt{(p-5)^2} = \sqrt{97}$

$p-5 = \pm\sqrt{97}$

$p = 5 \pm \sqrt{97}$

11) $3x^2 + 18x + 15 = -6$

12) $10r^2 - 20r - 40 = -10$

$$11) 3x^2 + 18x + 15 = -6$$

$$\left(\frac{3x^2}{3} + \frac{18x}{3} + \boxed{} \right) = -21 + \boxed{}$$

$$3 \left(x^2 + 6x + \boxed{9} \right) = -21 + 3 \boxed{9}$$

$$\frac{3(x+3)^2}{3} = \frac{6}{3}$$

$$\sqrt{(x+3)^2} = \sqrt{2}$$

$$x+3 = \pm\sqrt{2}$$

$$\begin{array}{r} x+3 = \sqrt{2} \\ -3 \quad -3 \end{array}$$

$$x = -3 + \sqrt{2}$$

$$\begin{array}{r} x+3 = -\sqrt{2} \\ -3 \quad -3 \end{array}$$

$$x = -3 - \sqrt{2}$$

3 boxes
since factored
out 3!

SRM

$$5) (p^2 + 14p + 60) = -5$$

$$\frac{p^2 + 14p + \boxed{49}}{-60 \quad -60} = \frac{-65 + \boxed{49}}{-60}$$

$$\sqrt{(p+7)^2} = \sqrt{-16}$$

$$p+7 = \boxed{\text{No real Solution}}$$

$$ax^2 + bx + c = 0$$

$$\rightarrow a=1, b=14, c=65$$

$$b^2 - 4ac$$

$$(14)^2 - 4(1)(65)$$

$$196 - 260$$

$$-64$$

$b^2 - 4ac$ is negative
No real
Solution

$$2) \quad p^2 - 2p - 39 = 0$$

$$p^2 - 2p + \boxed{1} = 39 + \boxed{1}$$

$$\sqrt{(p-1)^2} = \sqrt{40}$$

$$p-1 = \pm 2\sqrt{10}$$

$$\frac{p-1 = 2\sqrt{10}}{+1 \quad +1}$$

$$\boxed{p = 1 + 2\sqrt{10}}$$

$$\frac{p-1 = -2\sqrt{10}}{+1 \quad +1}$$

$$\boxed{p = 1 - 2\sqrt{10}}$$

Handwritten notes for completing the square:

- Original equation: $p^2 - 2p - 39 = 0$
- Step 1: Add 39 to both sides: $p^2 - 2p + \boxed{1} = 39 + \boxed{1}$
- Step 2: Take the square root of both sides: $\sqrt{(p-1)^2} = \sqrt{40}$
- Step 3: Solve for p : $p-1 = \pm 2\sqrt{10}$
- Step 4: Add 1 to both sides to solve for p :
 - Left side: $\frac{p-1 = 2\sqrt{10}}{+1 \quad +1} \Rightarrow \boxed{p = 1 + 2\sqrt{10}}$
 - Right side: $\frac{p-1 = -2\sqrt{10}}{+1 \quad +1} \Rightarrow \boxed{p = 1 - 2\sqrt{10}}$

Solve by Completing the Square

1. Add/subtract the Constant to the other side.
2. Factor out a if a is not 1. * occasionally
= "half the middle, square it"
3. Add $(b/2)^2$ to both sides of the equation.
4. Factor and write as a binomial Squared
5. Take the square root of both sides. Don't forget \pm !
6. Split into two equations and solve for x .

Ex 3: Solve each equation by completing the square.

a. $x^2 + 4x + 11 = 2$

$$\begin{array}{l} \underline{\quad -11 \quad -11} \\ x^2 + 4x + \boxed{4} = -9 + \boxed{4} \\ \sqrt{(x+2)^2} = \sqrt{-5} \end{array}$$

$$x+2 = \boxed{\text{no real solution}}$$

b. $2x^2 - 4x - 10 = 20$

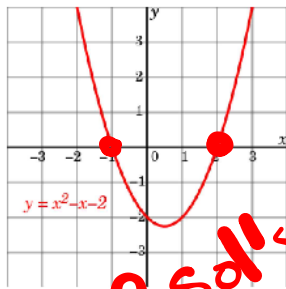
Answers to Solving Quadratic Equations: Completing the Square

- 1) $\{4, -6\}$ 2) $\{-6 + 3\sqrt{10}, -6 - 3\sqrt{10}\}$ 3) $\{5, 3\}$
4) $\{-4, -14\}$ 5) $\{11, -5\}$ 6) $\{2 + \sqrt{95}, 2 - \sqrt{95}\}$
7) $\{-8 + \sqrt{89}, -8 - \sqrt{89}\}$ 8) $\{4 + 2\sqrt{2}, 4 - 2\sqrt{2}\}$ 9) $\{-7 + 2\sqrt{3}, -7 - 2\sqrt{3}\}$
10) $\{5, -3\}$ 11) $\{-1, -13\}$ 12) $\{-2 + 3\sqrt{7}, -2 - 3\sqrt{7}\}$
13) $\left\{\frac{10 + \sqrt{70}}{5}, \frac{10 - \sqrt{70}}{5}\right\}$ 14) $\left\{\frac{3 + \sqrt{111}}{3}, \frac{3 - \sqrt{111}}{3}\right\}$ 15) $\left\{\frac{1 + \sqrt{37}}{6}, \frac{1 - \sqrt{37}}{6}\right\}$
16) $\left\{1, -3\frac{1}{2}\right\}$ 17) $\left\{1, -3\frac{3}{4}\right\}$ 18) $\left\{\frac{13 + 5\sqrt{37}}{18}, \frac{13 - 5\sqrt{37}}{18}\right\}$
19) $\left\{2\frac{1}{3}, 1\right\}$ 20) $\left\{5, \frac{1}{3}\right\}$

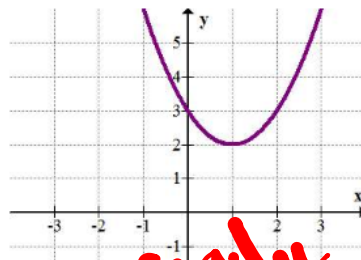
Quadratic Formula and the Discriminant

Remember, solutions to quadratic functions are also known as **zeroes, roots, and x-intercepts**.

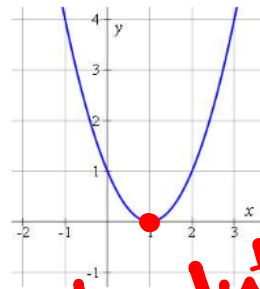
How many solutions does each graph below have? (think about the sentence above)



2 sol's



no real sol's



1 solution

The Discriminant

The discriminant is part of the quadratic formula. When you simplify the discriminant, it becomes a number that will tell you the number of solutions a quadratic function has.

Before finding the discriminant, you must make sure your equation is equal to zero

discriminant: $b^2 - 4ac$

If the discriminant is negative, there is/are no real solutions

If the discriminant is zero, there is/are One Solution

If the discriminant is positive, there is/are two solutions

$ax^2 + bx + c = 0$

For each equation below, determine the number of solutions.

1) $x^2 + 6x + 4 = 0$

$a=1$
 $b=6$
 $c=4$

$b^2 - 4ac$
 $6^2 - 4(1)(4)$
 $36 - 16 = 20$

2 sol's

2) $-3x^2 + 17x - 2 = 3$

$-3x^2 + 17x - 5 = 0$
 $a=-3$
 $b=17$
 $c=-5$

$b^2 - 4ac$
 $(17)^2 - 4(-3)(-5)$
 $289 - 60 = 229$

2 sol's

3) $3x + 7 = -5x^2 - 4$

$5x^2 + 3x + 11 = 0$
 $a=5$
 $b=3$
 $c=11$

$b^2 - 4ac$
 $3^2 - 4(5)(11)$
 $9 - 220 = -211$

no real solutions

5) $2x^2 - 3x + 2 = 0$

6) $9x^2 + 24x + 10 = -6$

